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Effect of the new insulation liner on noise levels in the CH124B (Sea King) aircraft

Bernadette Quémerais

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Principal Author

Original signed by Bernadette Quémerais, PhD

Bernadette Quémerais, PhD

Project Officer

Approved by

Original signed by LCol Paul Burke, MD

LCol Paul Burke, MD

Section Head, Aerospace and Undersea Medical Science Centre

Approved for release by

Original signed by K. C. Wulterkens

K. C. Wulterkens

for Chair, Document Review and Library Committee

Abstract

Crew members of the CH124B (Sea King) helicopter are exposed to elevated noise levels. To minimize noise levels as well as to insulate electrical wiring, the Sea King is equipped with a liner, which reduces noise. Recently the Sea King helicopters have been equipped with a new type of liner. Defence Research and Development Canada (DRDC) Toronto was asked to verify the noise levels in the Sea King during flight with the new liner and compare it with the old liner. Equivalent noise levels and octave band analysis were performed on a Sea King helicopter from Shearwater in February 5 and 6, 2008. Results showed that the new liner has absorption capabilities similar to or better than the old liner, except at the very low frequency of 8 Hz where absorption capability was lower for the new liner. Although at-ear sound pressure levels were not measured, it is reasonable to assume that they are acceptable with the new liner since they were acceptable with the old liner. Since sound pressure levels are significantly higher when the cargo door is open, it was recommended to open the door only for a short period of time to avoid excessive exposure for the crewmen and troops.

Résumé

Les membres d'équipage des hélicoptères CH124B Sea King sont exposés à des niveaux de bruit élevés. Afin de minimiser les niveaux de bruit ainsi que pour isoler les fils électriques à l'intérieur de la cabine, les Sea King sont équipés d'un isolant permettant la réduction du bruit. Récemment les hélicoptères Sea King ont été équipés d'un nouveau type d'isolant. Recherche et Développement pour la Défense Canada (RDDC) Toronto a été contacté pour vérifier les niveaux de bruit dans les hélicoptères Sea King avec le nouvel isolant et les comparer avec les niveaux obtenus avec l'ancien isolant. Des mesures de niveaux de bruit équivalent ainsi que des mesures de bande d'octave ont été effectuées dans un hélicoptère Sea King les 5 et 6 février 2008. Les résultats ont montré que le nouvel isolant a une capacité d'absorption équivalente ou meilleure que l'ancien isolant, sauf pour la très basse fréquence de 8 Hz pour laquelle la capacité d'absorption est plus faible pour le nouvel isolant. Bien que les niveaux de pression de son à l'oreille n'aient pas été mesurés, il est raisonnable de penser qu'ils sont acceptable avec le nouvel isolant puisqu'ils étaient acceptable avec l'ancien isolant. Puisque les niveaux de pression de son sont significativement plus élevés quand la porte cargo est ouverte, il a été recommandé de n'ouvrir la porte que pendant de courtes périodes de temps pour éviter une exposition au bruit trop élevée.

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Executive summary

Effect of the new insulation liner on noise levels in the CH124B (Sea King) aircraft

Bernadette Quémerais; DRDC Toronto TM 2008-182; Defence R&D Canada – Toronto; November 2008.

Introduction or background: Crew members of the CH124B (Sea King) helicopter are exposed to elevated noise levels. To minimize noise levels as well as to insulate electrical wiring, the Seaking are equipped with a liner, which reduces noise. The old liner was an impervious Mylar membrane MIL-C-7514B covered on each side by fiberglass. A study was previously performed by Defence and Civil Institute of Environmental Medicine (DCIEM) to verify the noise level with and without this type of liner ([1]). Recently, the Sea King helicopters have been equipped with a new type of liner made of closed cell foam covered by Herculight vinyl on each side. In September 2006, the Preventive Medicine Technicians (PMed Techs) from Canadian Forces Base (CFB) Stadaconna did a preliminary noise survey using a regular noise dosimeter. Unfortunately, the dosimeter does not allow the measurement of the noise level at various frequencies, which is necessary to compare with the previous study. Defence Research and Development Canada (DRDC) Toronto was asked to verify the noise levels in the Sea King during flight with the new liner and compare it with the old liner. Equivalent noise levels and octave band analysis were performed on a Sea King helicopter from CFB Shearwater on February 5 and 6, 2008.

Results: Overall results showed there is no significant difference between each position. Results showed that the new liner has absorption capabilities similar to or better than the old liner, except at the very low frequency of 8 Hz where absorption capability was lower for the new liner. Although at-ear sound pressure levels were not measured, it is reasonable to assume that they are acceptable with the new liner since they were acceptable with the old liner. Since sound pressure levels are significantly higher when the cargo door is open at low frequencies, it was recommended to open the door only for a short period of time to avoid excessive exposure for the crewmen and troops.

Sommaire

Effect of the new insulation liner on noise levels in the CH124B (Sea King) aircraft

Bernadette Quémerais; DRDC Toronto TM 2008-182; R & D pour la défense Canada – Toronto; Novembre 2008.

Introduction ou contexte: Les membres d'équipage des hélicoptères Sea King sont exposés à des niveaux de bruit élevés. Afin de minimiser les niveaux de bruit ainsi que pour isoler les fils électriques à l'intérieur de la cabine, les Sea King sont équipés d'un isolant permettant la réduction du bruit. L'ancien isolant était une membrane imperméable Mylar MIL-C-7514B recouverte de chaque côté de fibre de verre. Récemment les hélicoptères Sea King ont été équipés d'un nouveau type d'isolant fait de cellules fermées de mousse recouvertes de chaque côté d'un vinyl Herculight. En septembre 2006, les techniciens en médecine préventive (PMed Techs) de la Base des Forces Canadiennes (BFC) Stadaconna ont effectué des mesures préliminaires en utilisant un dosimètre de bruit. Une étude a été effectuée antérieurement par l'Institut de médecine environnementale pour la défense (IMED), pour vérifier le niveau de bruit avec et sans ce type d'isolant ([1]). Malheureusement ce dosimètre ne permet d'effectuer des mesures à chaque fréquence, ce qui était nécessaire pour effectuer la comparaison avec l'étude précédente. Recherche et Développement pour la Défense Canada (RDDC) Toronto a été contacté pour vérifier les niveaux de bruit dans les hélicoptères Sea King avec le nouvel isolant et les comparer avec les niveaux obtenus avec l'ancien isolant. Des mesures de niveaux de bruit équivalent ainsi que des mesures de bande d'octave ont été effectuées dans un hélicoptère Sea King les 5 et 6 février 2008.

Résultats: Les résultats généraux ont montrés qu'il n'y a pas de différence significative entre chaque position dans l'hélicoptère. En conclusion, le nouvel isolant a une capacité d'absorption équivalente ou meilleure que l'ancien isolant, sauf pour la très basse fréquence de 8 Hz pour laquelle la capacité d'absorption est plus faible pour le nouvel isolant. Bien que les niveaux de pression de son à l'oreille n'aient pas été mesurés, il est raisonnable de penser qu'ils sont acceptable avec le nouvel isolant puisqu'ils étaient acceptable avec l'ancien isolant. Puisque les niveaux de pression de son sont significativement plus élevés quand la porte cargo est ouverte, particulièrement aux basses fréquences, il a été recommandé de n'ouvrir la porte que pendant de courtes périodes de temps pour éviter une exposition au bruit trop élevée.

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Acknowledgements

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1 Introduction

In October 1994, a noise survey was performed by Defence and Civil Institute of Environmental Medicine (DCIEM) on the CH124B (Sea King) aircraft to verify the effect off the sound insulation blanket on the noise levels inside the aircraft ([1]). The liner used at the time was an impervious Mylar membrane MIL-C-7514B covered on each side by fiberglass.

In 2006, the sound insulation blanket used in the CH124 B aircraft was replaced by a new liner. This new liner is composed of closed cell foam covered by Herculight vinyl on each side. It was requested to perform a noise survey with the new liner to verify its sound insulation capabilities.

In September 2006, the Preventive Medicine Technicians (PMed Techs) from Canadian Forces Base (CFB) Stadaconna did a preliminary noise survey using a regular noise dosimeter. Unfortunately, the dosimeter does not allow the measurement of the noise level at various frequencies, which was necessary to compare with the previous study.

In November 2007, it was agreed that a new noise survey allowing for octave band analysis be performed by Defence Research and Development Canada (DRDC) Toronto on the CH124 B aircraft ([2]). This study did not include the speech impairment experiment as in the previous study nor did it include personal noise exposure.

2 Method

Sound pressure levels were measured using a Sound Track LxT sound level meter from Larson Davis Inc., Provo, Utah. This instrument allows for the measurement of sound pressure levels at specific frequencies: either the full octave (12 frequencies from 8 to 16,000 Hz) or 1/3 octave (36 frequencies from 6.3 to 20,000 Hz). For the purpose of the survey, it was decided to measure the 1/3 octave since the full octave can be recalculated from the former. At the same time, the instrument calculates the long-term ambient equivalent levels for each set of measurements. This level is calculated using the A-weighted scale. The A-weighted scale is representative of the hearing of the human since it is most sensitive to noise in the 1000-3000 Hz frequency region.

For operational reasons, it was decided to test only the new liner and to use the old test for comparison. Since the study was performed in a different aircraft, slight differences between both studies can be attributed to the difference in aircraft and/or different weather conditions (the study was done during a snow storm).

Measurements were taken for 2 minutes at four different locations inside the aircraft: the co-pilot seat, the Airborne Electronic Sensor Operator (AES Op) seat, the crewman seat (near the cargo door) and the aft troop seat (in front of the cargo door). Results are expressed in sound pressure levels (dBA).

Due to operational requirements and bad weather, the study had to be performed over two days using the same aircraft for both days. Measurements were taken on February 5 and 6, 2008. The specifics of each flight are given in Table 1.

Table 1. Specifics of each flight

	Ground	Hover	Cruise*	Cargo door Closed	Cargo door Open
Flight 1	x		x	x	x
Flight 2		x		x	x

*Cruise was performed at various speeds: 60, 90 and 120 knots; for safety reasons, the door had to be closed at all times at 120 knots

3 Results and discussion

3.1 Average long-term equivalent noise levels

Average long-term ambient equivalent levels and (standard deviations) at each position are given in Table 2.

Table 2. Long-term equivalent noise levels

	Overall (dBA)	Door closed (dBA)	Door open (dBA)	Ground (dBA)	Hover (dBA)	Forward (dBA)
Co-pilot	98.7 (0.8)	98.4 (0.7)	98.9 (0.9)	99.2 (0.4)	97.9 (0.1)	98.8 (0.8)
AES Op	98.3 (1.5)	98.2 (1.7)	98.4 (1.5)	97.9 (1.2)	100.7 (0.3)	97.5 (0.7)
Crewman	99.5 (2.4)	99.1 (2.4)	100.1 (2.5)	98.6 (1.3)	103.4 (0.4)	98.3 (1.0)
Aft troop	98.8 (1.7)	97.8 (1.1)	100.1 (1.4)	97.8 (1.3)	100.4 (2.1)	98.6 (1.4)
Overall	98.8 (1.7)	98.4 (1.6)	99.4 (1.7)	98.3 (1.1)	100.6 (2.3)	98.3 (1.1)

Overall, there is no significant difference between each position. Except for the co-pilot and the aft troop positions, levels are significantly higher at hover than at forward cruise and at ground level. They are slightly higher with the door open at the crewman and the aft troop positions, although the difference is not really significant. Although not shown here, there was no significant difference between the sound pressure levels at 60, 90 or 120 knots.

3.2 Long-terms equivalent noise levels at various positions

The previous study measured long-term ambient levels at the co-pilot and AES Op positions. Comparison with results in this study is presented in Table 3.

Table 3.Long-term equivalent noise levels at the co-pilot position

Flight regime	Previous liner	New liner	Difference
Static Hover	99.5 dBA (0.9)	97.9 dBA (0.1)	1.7 dBA
Forward cruise	100.7 dBA (1.1)	98.8 dBA (0.8)	1.9 dBA

Table 4. Long-term equivalent noise levels at the AES Op position

Flight regime	Previous liner	New liner	Difference
Static Hover	104.9 dBA (0.9)	100.7 dBA (0.3)	4.2 dBA
Forward cruise	101.7 dBA (1.4)	97.5 dBA (0.7)	4.2 dBA

There is a significant difference between the two liners at the co-pilot position during hover and at the AES Op position during both hover and forward cruise. Since decibel is a logarithmique scale, an increase of 3 dBA represents a doubling of acoustic energy. Since the difference is quite significant, it can be estimated that the decrease in sound pressure level is due to the liner and not to the fact that the study was performed in a different aircraft. The PMed Techs also observed a significant decrease at the AES Op position, which confirms the findings.

3.3 Octave band analysis at various positions

Figures 1 to 4 show the sound pressure level at frequencies over the full octave band. The variations in sound pressure levels at the various frequencies are similar to the variations observed in the previous study ([1]). Most of the differences observed between the two studies could be due to the fact than the current study was done on a different aircraft with different weather conditions. Levels are higher at low frequencies, decreasing after 500 Hz and increasing again after 4000 Hz. This is expected since it is easier to shield high frequencies than low frequencies. However, the sound level pressure is significantly higher in the current study at 8 Hz than in the other study. It is possible that vibration of the rotor blades induced a higher sound pressure level at this low frequency. It is also possible than the old liner has a better absorption capabilities at low frequencies. However, this does not affect the overall absorption capabilities since low frequencies have a lower impact on the overall long-term ambient equivalent level. The sound pressure level at 8 Hz is also significantly higher at hover than during forward cruise.

Figure 1. Hoover, door closed, co-pilot position

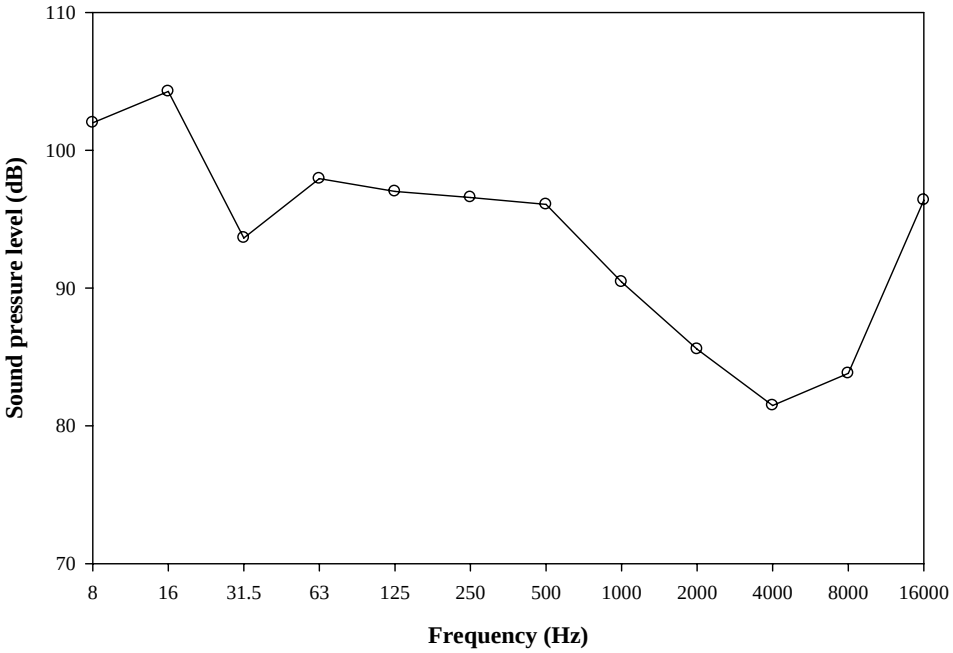


Figure 2. Forward cruise, 60 knots, door closed, co-pilot position

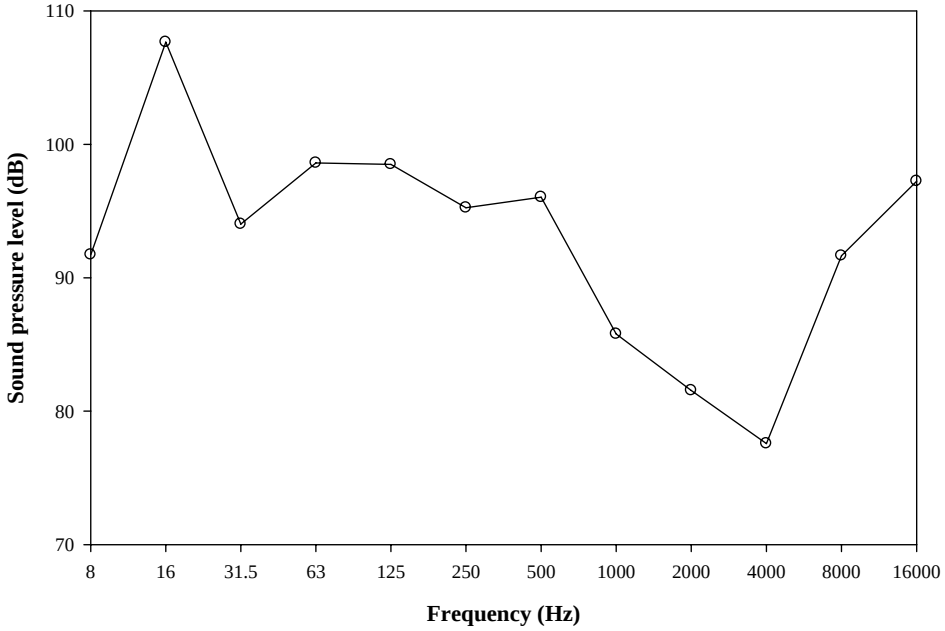


Figure 3. Hover, door closed, AES Op position

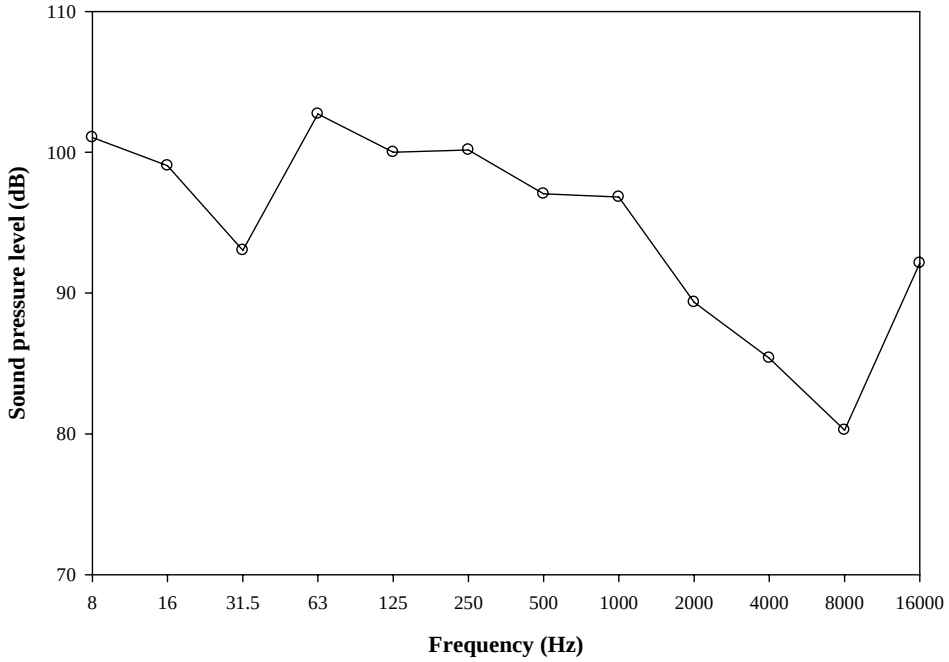
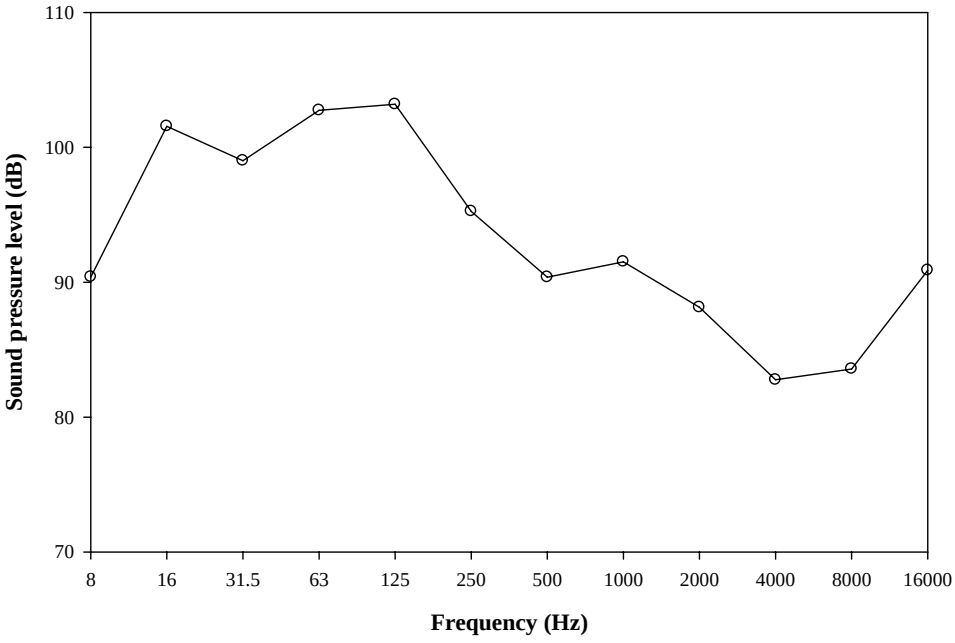


Figure 4. Forward cruise, 60 knots, door closed, AES Op position



3.4 Octave band analysis at each position during forward cruise at 60 knots

Figures 5 to 8 show the variations in sound pressure levels at various frequencies for each position during forward cruise at 60 knots. Sound pressure levels are generally higher at all frequencies at all positions when the cargo door is open. They are significantly higher for frequencies from 8 to 31.5 Hz at all positions, and significantly higher at frequencies higher than 4000 Hz for the crewman and the aft troop positions when the door is open. However, it is expected that higher levels may be found for the crewman and aft troop positions when the door is open since they are closer to the door than the AES Op and the co-pilot positions. Considering that the human ear is most sensitive to frequencies from 1000 to 3000 Hz, it is recommended that the door be kept open for the shortest time possible in order to protect the crewmen and the troops.

Figure 5. Co-pilot position

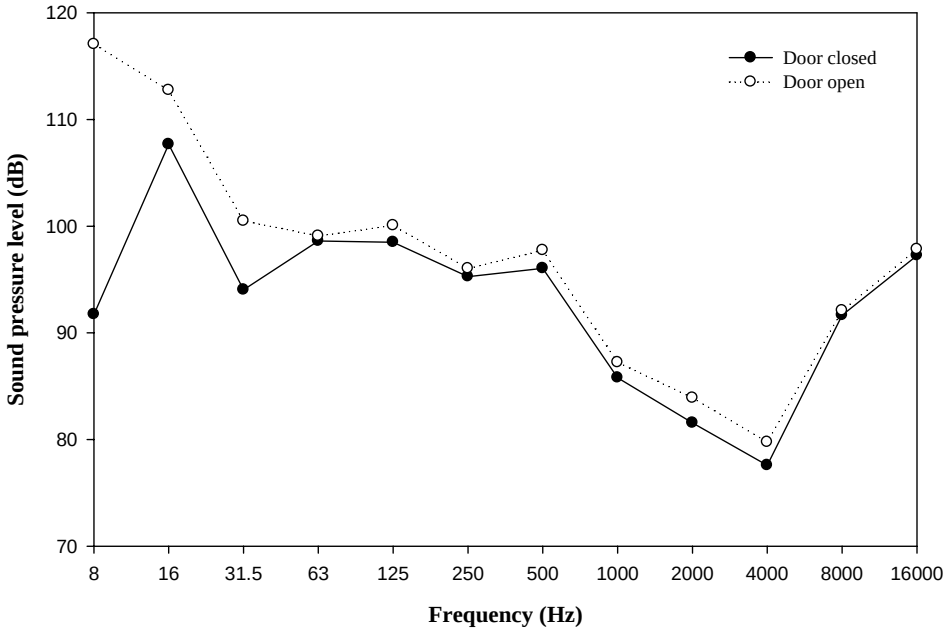


Figure 6. AES Op position

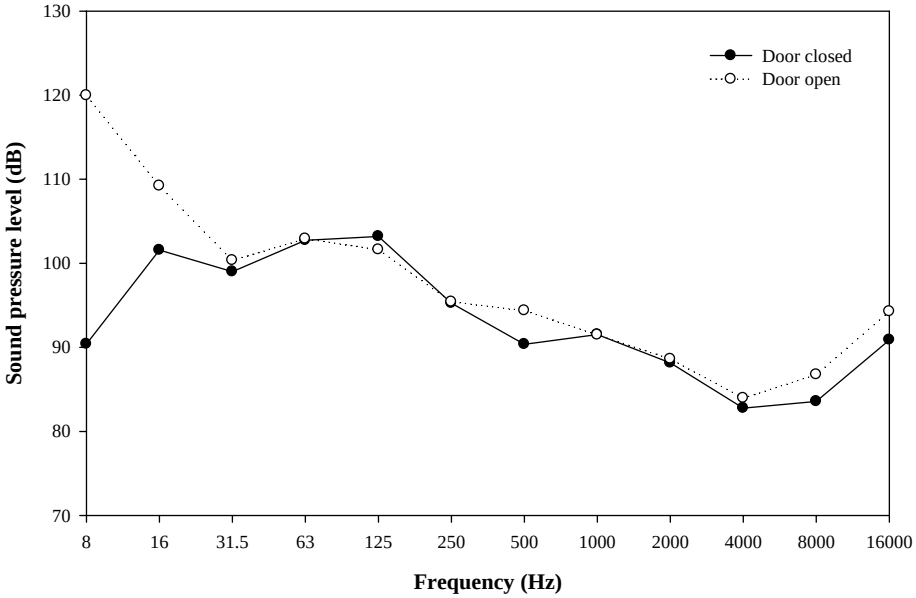


Figure 7. Crewman position

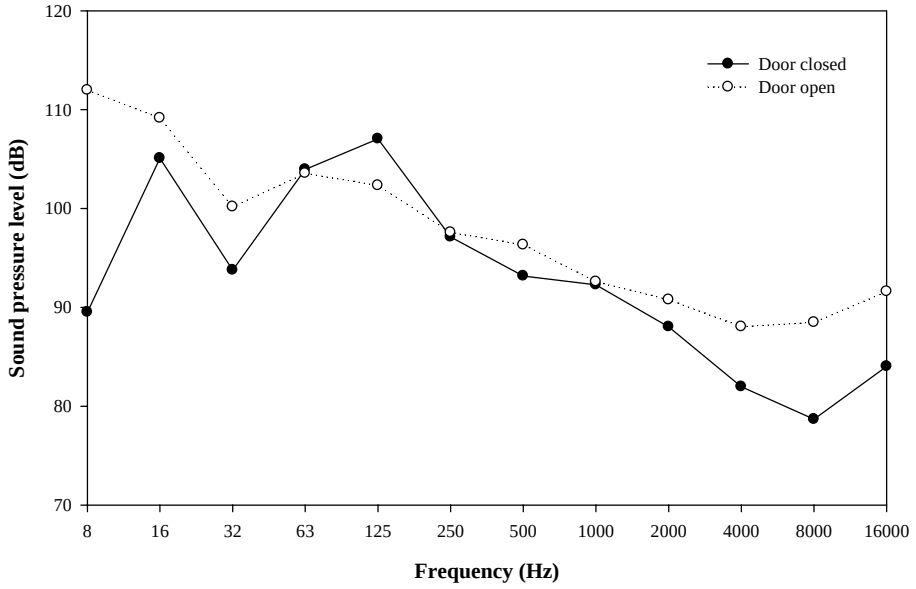
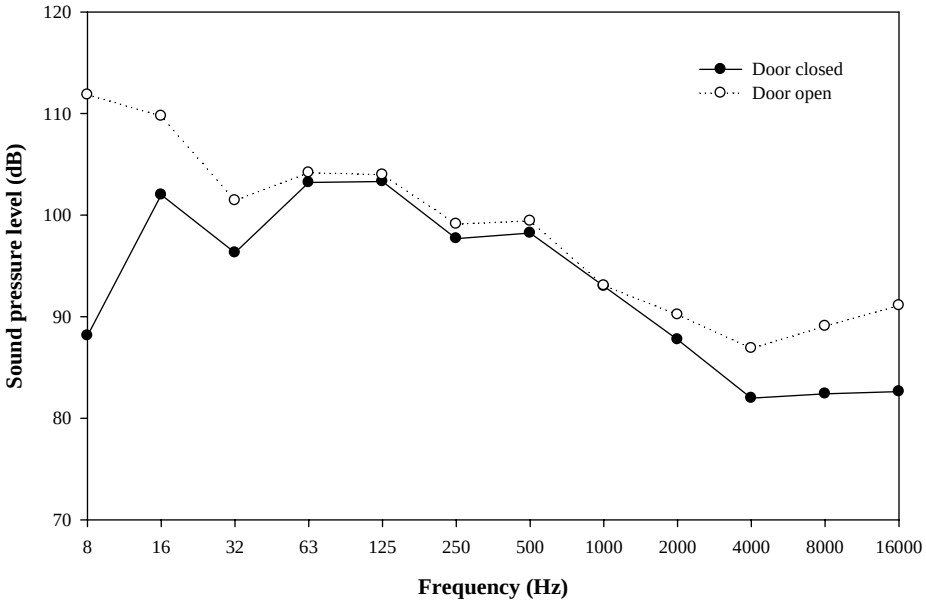


Figure 8. Aft troop position



4 Conclusion

Although this study did not test the old liner, the results show that the new liner has absorption capabilities similar to or better than the old liner, except at the very low frequency of 8 Hz. Although measurement at-ear sound pressure levels were not conducted, it is reasonable to assume that they are acceptable with the new liner since they were acceptable with the old liner. Since sound pressure levels are significantly higher when the cargo door is open, it is recommended that the door be opened only for a short period of time to avoid excessive exposure for the crewmen and troops.

References

[1] Brian Crabtree (1994) - DCIEM report on the effect of sound insulation blanket on noise levels in the Sea King helicopter

[2] STO/DEE Project 20he 21 Agreement Form

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List of symbols/abbreviations/acronyms/initialisms

DND	Department of National Defence
OPI	Office of Primary Interest
R&D	Research & Development
DCIEM	Defence and Civil Institute of Environmental Medicine
PMed Techs	Preventive Medicine Technicians
CFB	Canadian Forces Base
BFC	Base des Forces Canadiennes
DRDC	Defence Research and Development Canada
RDDC	Recherche et Développement Défense Canada
AES Op	Airborne Electronic Sensor Operator
ADM (Mat)	Assistant Deputy Minister Materiel
DAEPM	Directorate of Aerospace Equipment Program Management (Maritime)

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Crew members of the CH124B (Sea King) helicopter are exposed to elevated noise levels. To minimize noise levels as well as to insulate electrical wiring, the Sea King is equipped with a liner, which reduces noise. Recently the Sea King helicopters have been equipped with a new type of liner. Defence Research and Development Canada (DRDC) Toronto was asked to verify the noise levels in the Sea King during flight with the new liner and compare it with the old liner. Equivalent noise levels and octave band analysis were performed on a Sea King helicopter from Shearwater in February 5 and 6, 2008. Results showed that the new liner has absorption capabilities similar to or better than the old liner, except at the very low frequency of 8 Hz where absorption capability was lower for the new liner. Although at-ear sound pressure levels were not measured, it is reasonable to assume that they are acceptable with the new liner since they were acceptable with the old liner. Since sound pressure levels are significantly higher when the cargo door is open, it was recommended to open the door only for a short period of time to avoid excessive exposure for the crewmen and troops.

Les membres d'équipage des hélicoptères CH124B Sea King sont exposés à des niveaux de bruit élevés. Afin de minimiser les niveaux de bruit ainsi que pour isoler les fils électriques à l'intérieur de la cabine, les Sea King sont équipés d'un isolant permettant la réduction du bruit. Récemment les hélicoptères Sea King ont été équipés d'un nouveau type d'isolant. Recherche et Développement pour la Défense Canada (RDDC) Toronto a été contacté pour vérifier les niveaux de bruit dans les hélicoptères Sea King avec le nouvel isolant et les comparer avec les niveaux obtenus avec l'ancien isolant. Des mesures de niveaux de bruit équivalent ainsi que des mesures de bande d'octave ont été effectuées dans un hélicoptère Sea King les 5 et 6 février 2008. Les résultats ont montré que le nouvel isolant a une capacité d'absorption équivalente ou meilleure que l'ancien isolant, sauf pour la très basse fréquence de 8 Hz pour laquelle la capacité d'absorption est plus faible pour le nouvel isolant. Bien que les niveaux de pression de son à l'oreille n'aient pas été mesurés, il est raisonnable de penser qu'ils sont acceptable avec le nouvel isolant puisqu'ils étaient acceptable avec l'ancien isolant. Puisque les niveaux de pression de son sont significativement plus élevés quand la porte cargo est ouverte, il a été recommandé de n'ouvrir la porte que pendant de courtes périodes de temps pour éviter une exposition au bruit trop élevée.

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Noise, Sea King, CH124B

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